Do we really need the Photon?

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june 2024

Black Body Radiation (BBR)
Max Planck introduced the notion of energy packages of electromagnetic radiation at frequency f of size hf to account for the observed spectra.
Albert Einstein linked these energy packages to Quantum Oscillators (QO) with energy content related to some internal "oscillation" by ε_{QO}= hf + const, where the light field at frequency f_L produces a transition between QO-states separated by $hf_L = \varepsilon^1_{QO} - \varepsilon^2_{QO}$.
The light field in the Einstein treatment remains entirely classical and the radiation's "quantized' nature is only due to the "Quantum Oscillators".

Photo Effect
A "modern" treatment of the photo effect would be to use the formalism of many-particle physics with electron quasi-particles whose dynamics is given by the Schrödinger equation. This is a continuation of the notion of the Quantum Oscillator, already encountered.
In order to liberate an electron from a (solid) material, one has to lift it at least from its energy at the electron chemical potential (CP) (Fermi level) to the energy of the vacuum (V). The electron is treated as a Quantum Oscillator (see above) and an incident *classical* light field (A) of frequency
$hf_A = \varepsilon_V - \varepsilon_{CP}$
will produce this (resonant) transition.
When the incident field is strong (great amplitude), the absorption of the required energy content will be fast and the rate of electron liberation, that is the photo current, will be high.
If the amplitude is weak, the *classical* field will take longer to furnish the quantum transition energy and the corresponding photo current will be weaker.
So, once again, we have no need for the photon.

Laser
The photon interpretation poses some problems with light statistics in Lasers. This led R.J. Glauber to postulate "coherent states" in lasers. What he did was essentially to reproduce *classical* fields from the photon formalism.
Free-electron "lasers", in particular, have no need for neither Quantum Oscillators nor photons, since they rely entirely on (blue-shifted) *classical* radiation.

Photon Quantum Limit
In Quantum Electrodynamics, an innocent traveling wave becomes a linear superposition of photon creation and destruction operators ($a^+ + a^-$). A light wave at frequency f whose energy content falls below hf cannot exist. This makes perfect sense from the standpoint of a Quantum Oscillator who needs the energy hf to detect anything.
But from the point of view of a SQUID (Superconducting Quantum Interference Device), this definition is incomplete. A SQUID needs no quantum transition for detecting a light field since it is powered by an external current and the light field triggers a switch by interference.
This brings us back to the continuous *classical* electromagnetic field.

Quantum Electrodynamics (QED)
The only quantity accurately calculated by QED, after its measurement, is the electron anomalous magnetic moment. When one looks at the calculation, this is due to single-electron self-interaction via the photon field. In other words, single-electron bremsstrahlung.
The need for a photon field, of infinite amplitude of course, arises from the postulate that single electrons do not self-interact.
But if you allow self-interaction, a *classical* field will immediately do.
The "need" of no self-interaction comes from atomic physics where a rather naive model of point nuclei acting on electrons, employing Schrödinger's equation reproduces the Balmer spectrum, already "derived " by the Bohr postulates. Same goes for the Dirac equation that yields the fine structure, already predicted by the Sommerfeld treatment.
Meaning that the Schrödinger-Dirac treatment is no more "fundamental" than the Bohr-Sommerfeld treatment. Thus, outlawing self-interaction is unjustified and must be abandoned.

Conclusion
The assumption of quantum oscillators in the sense of a multi-"particle" fermion field (electrons, "protons", etc) governed by the Schrödinger or Dirac equation, (self)-interacting by *classical* fields, should be enough of an hypothesis (which is already complicated enough).
The photon model turns out to be a phenomenological shortcut to brush a real ab-initio treatment "under the rug" (Feynman) and should be hitherto dicarded.